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71) Anmelder:
Towfigh, Abdoll-Hosseini, Dr. med., 4330 Mülheim,
DE

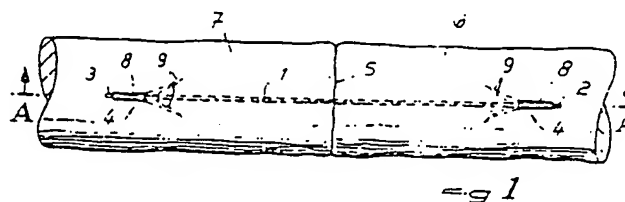
⑦2 Erfinder:
gleich Anmelder

Prüfungsantrag gem. § 44 PatG ist gestellt

⑤4) Vorrichtung zur Herstellung einer Sehnen-Stoßnaht

Vorrichtung zur Herstellung einer Sehnen-Stoßnaht, bestehend aus einem Zugmittel mit zwei Zugmittellenden und Blockiermittel. Das Zugmittel ist mit einem Zugmittellende nadelartig und die Stoßstelle überbrückend in den einen der zu verbindenden Sehnenstümpfe einführbar sowie aus dem anderen Sehnenstumpf wieder herausführbar. Von den Zugmittellenden ist eines mit einem festen Blockiermittel versehen, an das freie Zugmittellende ist ein anderes Blockiermittel anschließbar. Beide Blockiermittel sind als Mehrarmanker ausgeführt, die eine zentrale Zugmittelaufnahme für das Zugmittel und zur Sehne hin gebogene Ankerarme aufweisen. Das Zugmittel ist als Drahtseil aus einer Mehrzahl von dünnen Drähten aufgebaut. Zumindest der an das freie Zugmittellende anschließbare Mehrarmanker ist mittels Preßverbindung, z.B. durch Festklemmen per Zange, auf dem Zugmittel befestigbar.

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(71) Applicant:
Towfigh, Abdoll-Hosseini, Dr. med., 4330 Mülheim, DE

(72) Inventor: Same as applicant

Request for examination pursuant to §44 patent Law has been made.

(54) Device for production of a tendon butt suture

Device for production of a tendon butt suture, comprising a traction mechanism with two traction-mechanism ends and blocking mechanisms. The traction mechanism can be introduced with one end in a needle-like manner, bridging the suture point, into one of the tendon stumps that are to be joined, and can be guided out of the other tendon stump. Of the traction-mechanism ends, one of them is provided with a fixed blocking mechanism; another blocking mechanism is attachable at the free end of the traction mechanism. Both blocking mechanisms are formed as multiple-arm anchors which have a central holder for the traction mechanism and anchor arms that are bent toward the tendon. The traction mechanism is constructed as a wire rope comprising a plurality of thin wires. At least the multiple-arm anchor that is connectable to the free end of the traction mechanism can be fastened to the traction mechanism by means of a press connection, e.g., by wedging it in with forceps or the like.

Andrejewski, Honke & Partner

Patent Attorneys

Grad. Physicist

Dr. Walter Andrejewski

Grad. Engineer

Dr.-Eng. Manfred Honke

Grad. Physicist

Dr. Karl Gerhard Masch

Attorney file:

4300 Essen 1, Theaterplatz 3, P.O. Box 100254

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Application for patent and auxiliary utility model

Dr. med. Abdoll-Hosseini Towfigh

Nachbarsweg 80, D-4330 Mülheim/Ruhr

Device for production of a tendon butt suture

Patent claims:

1. Device for production of a tendon butt suture, comprising

a traction mechanism with two traction-mechanism ends and blocking mechanisms,

wherein the traction mechanism can be introduced with one end in a needle-like manner, bridging the abutment, into one of the tendon stumps that are to be joined, and can be guided out of the other tendon stump; furthermore, of the traction-mechanism ends, one of them is provided with a fixed blocking mechanism; another blocking mechanism is attachable at the free end of the traction mechanism, characterized in that the blocking mechanisms are formed as multiple-arm anchors (4)

which have a central holder (8) for the traction mechanism (1) and anchor arms (9) that are bent toward the tendon (6, 7),

that the traction mechanism (1) is constructed as a wire rope comprising a plurality of thin wires (10) and that at least the multiple-arm anchor (4) that is connectable to the free end

(3) of the traction mechanism can be fastened to the traction mechanism (1) by means of a press connection.

2. Device according to claim 1, characterized in that the multiple-arm anchors (4) are Y-shaped in plan view, with the traction-mechanism holder (8) being disposed in the trunk of the Y or the trunk of the Y being formed as a traction-mechanism holder (8), and that both the Y-trunk (8) and also the Y-arms (9) are bent toward the associated tendon (6, 7).

3. Device according to claim 2, characterized in that the Y-trunk is formed as a clamping sleeve (8) for the associated end (3) of the traction mechanism.

4. Device according to any of claims 2 or 3, characterized in that the Y-arms (9) and the Y-trunk (8) grab with their ends into the surface of the associated tendon (6, 7) in the installed state.

5. Device according to any of claims 1 to 4, characterized in that the Y-trunks (8) of the multiple-arm anchors (4) are bent in accordance with the curvature of a traction mechanism (1) which is guided in an essentially sinusoidal manner, and that curvature is continued in the Y-arms (9).

6. Device according to any of claims 1 to 5, characterized in that in the installed state the multiple-arm anchors (4) with their Y-trunks (8) guided in the direction of the traction mechanism (1) face away from each other, and the Y-arms (9) face toward each other.

The invention relates generically to a device for production of a tendon butt suture, comprising

a traction mechanism with two traction-mechanism ends and blocking mechanisms,

wherein the traction mechanism can be introduced with one end in a needle-like manner, bridging the abutment, into one of the tendon stumps that are to be joined, and can be guided out of the other tendon stump; furthermore, of the traction-mechanism ends, one of them is provided with a fixed blocking mechanism and another blocking mechanism is attachable at the free end of the traction mechanism.

- The term "tendon" is used in a medical sense within the context of the invention. It designates shorter or longer, essentially funicular formations of connective tissue of high tensile strength which join the skeletal muscles of man and vertebrate animals to the skeleton and via which the muscles attach to the bone or come off it. The tendons are regularly surrounded by a doubled-walled fibrous sheath, the so-called peritenon or tendon sheath. The space between the inner and outer membranes connected to the tendon is filled with a lubricant. In that sense, the tendon can be said to be in a slide bearing. A butt suture designates a suture in which two tendon stumps abut against each other with more or less orthogonal end faces. A tendon butt suture in which the traction mechanism is introduced into one of the tendon stumps that are to be connected, bridges the abutment and is led back out of the other tendon stump is often called a recessed butt suture.

In the case of the generic devices known from practice, in the installed state of the device the blocking mechanisms block any undesired movement of the traction mechanism relative to the tendon or the tendon stumps. The blocking mechanisms are, for example, lead balls clamped onto one end of the traction mechanism, clamped-on elements of some other form, or loops, twists or knots in the traction mechanism itself. Actually, the known devices are not intended to remain in the patient's body; they "don't stay put". Rather, the traction mechanism has to be pulled out again once the healing process is completed. Consequently, the known blocking mechanisms are not components that are adapted to the tendon, catch in the tendon or in the surface of the tendon, and represent what could be called an anchor. When the known devices are used, bruises and strangulations frequently occur at at least one of the tendon stumps owing to the blocking actions or blocking mechanisms. Today it

is known that such bruises and strangulations of the tendon tissue by the suture material are the reason for the adhesions --often associated with considerably reduced function-- between the tendon suture and the slide bearing owing to avascular necrosis of the tendon tissue.

The underlying problem addressed by the invention is to create a device for the production of a tendon butt suture which makes possible the creation of a tendon butt suture that is free of bruises and strangulations and that can stay in place in its entirety, i.e., with its traction mechanism and with its blocking mechanisms, after the healing. It is understood that, to that end, all components of the device according to the invention are made of an implantable material, e.g., implantable steel, which of course is also already the case for the known devices.

To solve that problem, the invention teaches that the blocking mechanisms are constructed as multiple-arm anchors which have a central holder for the traction mechanism and anchor arms that are bent toward the tendon, that the traction mechanism is constructed as a wire rope comprising a plurality of thin wires, and that at least the multiple-arm anchor that is connectable to the free end of the traction mechanism can be fastened to the traction mechanism by means of a press connection, i.e., by wedging it in with forceps or the like. The multiple-arm anchor that is fixed to the traction mechanism can also be connected to the traction mechanism via a press connection, but in principle could also be permanently welded or permanently glued on in a corresponding manner. Traction mechanisms in the form of a wire rope comprising a plurality of thin wires are well-known in surgery.

In the device according to the invention, the multiple-arm anchor is first fitted to the tendon of essentially circular cross-section by means of the anchor arms which are bent in the described manner -- and in first approximation the bending of the arms is so implemented. But the bending has a further effect, namely also an anchoring. In this context, the multiple-arm anchors can have any shape in principle, provided only that it is ensured that their arms fit the tendon adequately and anchor adequately in the tendon or in the tendon's surface. A preferred embodiment of the invention is characterized in that the multiple-arm anchors are Y-shaped in plan view, with the traction-mechanism holder being disposed in the trunk of the Y or the trunk of the Y being formed as a traction-mechanism holder, and that both the Y-trunk and also the Y-arms are bent toward the associated tendon. According

to another proposal of the invention, the Y-trunk is formed as a clamping sleeve for the associated end of the traction mechanism in order to fasten the traction mechanism formed as a wire rope in the traction-mechanism holder. It is recommended that the Y-arms and the Y-trunk be so formed that in the installed state they grab a little with their ends into the surface of the associated tendon. In regard to application of a traction stress with simultaneous good anchoring, an embodiment that has proved itself to be especially advantageous is one in which the Y-trunks are bent in accordance with the curvature of a traction mechanism which is guided in an essentially sinusoidal manner in the installed state, that curvature being continued in the Y-arms too. The anchoring is especially effective if the device is configured such that in the installed state the multiple-arm anchors with their Y-trunks guided in the direction of the traction mechanism face away from each other, and the Y-arms face toward each other. That embodiment is of special importance.

Expressed differently, the invention involves a double-anchor technique for tendon restoration which does not strangle and only minimally traumatizes the tendon tissue, is recessed into the tendon and on both sides has such a stable anchoring that full functional load-bearing capacity is ensured post-operatively without any fixating bandage. The entire suture construction consists of practically only the thin wire cable which is introduced into the tendon's cross-section on both sides of the abutment and is anchored in the described manner at both ends. The multiple-arm anchors are flush with the tendon's surface in the longitudinal direction. The base surface and therewith the surface pressure can be adjusted without difficulty in such a manner that the vascular supply of the tendon is not additionally compressed under the traction stresses that the traction mechanism has to absorb. An additional adaptation suture at the tendon stumps is not necessary. Consequently, the device according to the invention allows a very simple suturing technique. Moreover, the fixed anchorings allow not only the primary tendon suture but also a secondary restoration by direct union of the mobilized and freshened tendon stumps. Since the multiple-arm anchors are fitted at the tendon's surface, lie flush with it and slightly notch into it, there is no irritation of the sliding tissue, so that the peritenon can be closed in a primary manner via the tendon suture. Adhesions no longer occur between the tendon suture and the slide bearing. Especially advantageous is the fact that a post-operative immobilization is no longer necessary when the device according to the invention is used. Active exercising can be started as soon as the wound pain has subsided, usually just one or two days after the operation. In the case of secondary restorations of the tendon, a convalescence of about

fourteen days in a wadding dressing, without application of a rigid dressing, is appropriate. It is understood that the device according to the invention and its multiple-arm anchors will be produced and supplied in various sizes for application in tendons of various diameters.

The invention will be explained hereinbelow in more detail with the aid of a drawing which illustrates only one exemplary embodiment. Shown diagrammatically are:

Fig. 1 a top view of a device according to the invention in the installed state;

Fig. 2 a cross-section in the direction A-A through the object in Fig. 1;

Fig. 3 a multiple-arm anchor of the device according to the invention in perspective view at a scale substantially enlarged in comparison to Fig. 1 and 2.

The device illustrated in the Figures is used to produce a tendon butt suture. In its basic construction, it consists of a traction mechanism 1 with two traction-mechanism ends 2, 3 and blocking mechanisms 4. The traction mechanism 1 can be introduced with one end 2 in a needle-like manner, bridging the abutment 5, into one of the tendon stumps 6 that are to be joined, and can be guided out of the other tendon stump 7. Of the traction-mechanism ends 2, 3, one of them 2 is provided with a fixed blocking mechanism 4, while another blocking mechanism 4 is attachable at the free end 3 of the traction mechanism. It is understood that this free end 3 of the traction mechanism 1 is also provided with a needle or can be formed as a needle, which is removed after the insertion of the second blocking mechanism 4, just as the free end 3 of the traction mechanism projecting beyond the second blocking mechanism 4 can also be removed.

From a comparative analysis of Fig. 1 and 2, on the one hand, and the perspective illustration in Fig. 3, on the other hand, it can be seen that the blocking mechanisms 4 are formed as multiple-arm anchors. They have a central holder 8 for the traction mechanism 1 and anchor arms 9 that are bent toward the tendon 6, 7. The traction mechanism 1 is constructed as a wire rope comprising a plurality of thin wires 10. At least the multiple-arm anchor that is connectable to the free end 3 is fastened to the traction mechanism 1 or is fastenable to the traction mechanism 1 by means of a press connection.

In the exemplary embodiment and according to a preferred embodiment of the invention, the multiple-arm anchors are Y-shaped in plan view. The traction-mechanism holder 8 is disposed in the Y-trunk. In the exemplary embodiment, the Y-trunk is formed as a sleeve-shaped holder 8 for the traction mechanism. Both the Y-trunk 8 and the Y-arms 9 are bent toward the associated tendon 6, 7, and are fitted to the tendon. The arrangement is made such that the Y-arms 9 and the Y-trunk 8 grab a little with their ends into the surface of the associated tendon 6, 7 in the installed state. In particular, it can be seen from Fig. 2 that the Y-trunks 8 are bent in accordance with the curvature of a traction mechanism 1 which is guided in an essentially sinusoidal manner, that curvature being continued in the Y-arms 9. The Figures also show the preferred embodiment of the invention which is characterized in that in the installed state the multiple-arm anchors 4 with their Y-trunks 8 guided in the direction of the traction mechanism 1 face away from each other, and the Y-arms 9 face toward each other.

Fig. 1

Fig. 2

Fig. 3

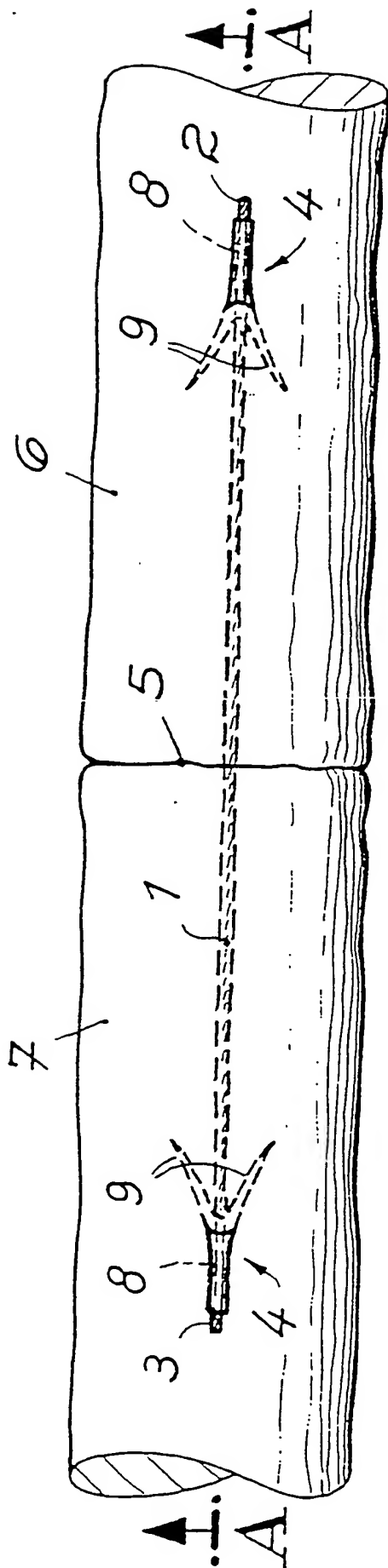


Fig. 1

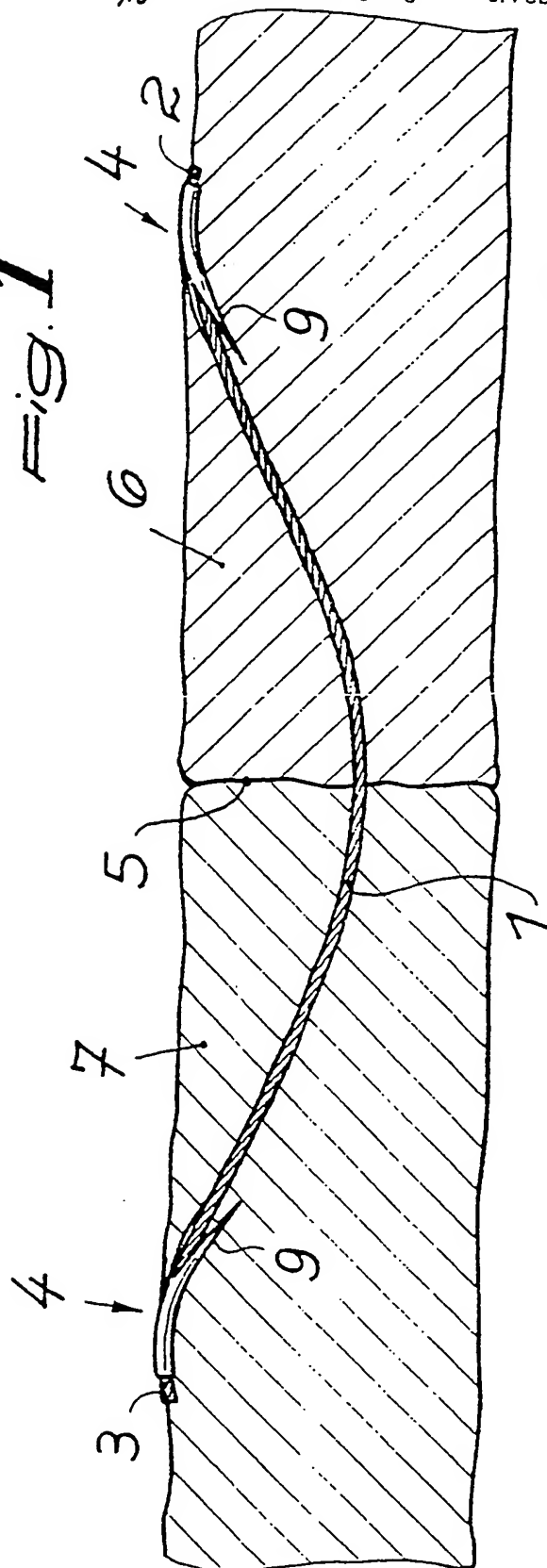


Fig. 2

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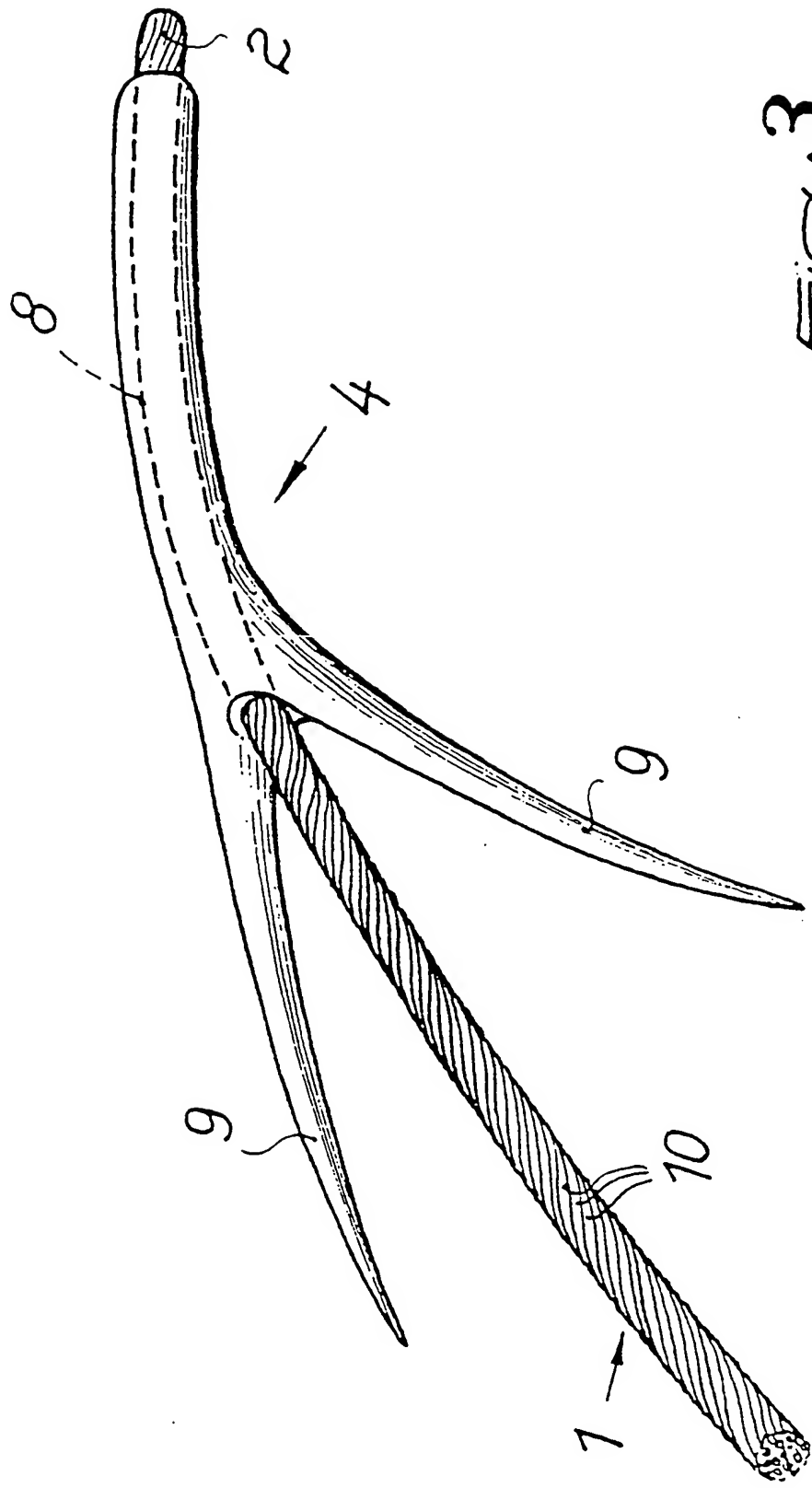


Fig. 3